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GB 1467834
GB 1261774
GB 822856
GB 327845
US 3014587
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(54) Method and apparatus for washing particulate material

(57) Hydrocarbon contaminants are washed from drilling fluid cuttings or other contaminated particulate matter by depositing the particulate matter on a screen 12 that may be downwardly inclined and spraying the particles by sprays 22 with a wash solution that may be collected by means 24 and recycled. The particles are caused to move away from the spray zone and may be further washed, for instance on a second downwardly inclined vibrating screen 14.

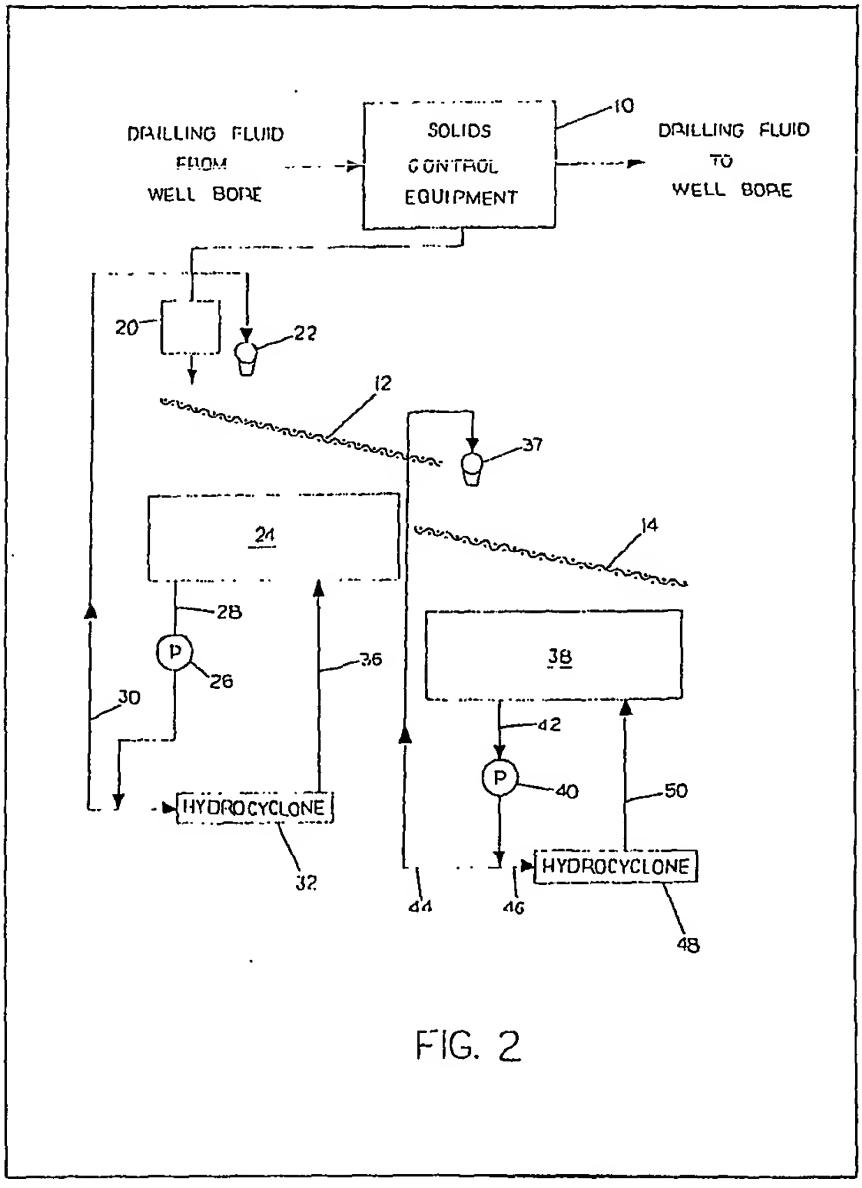

FIG. 2

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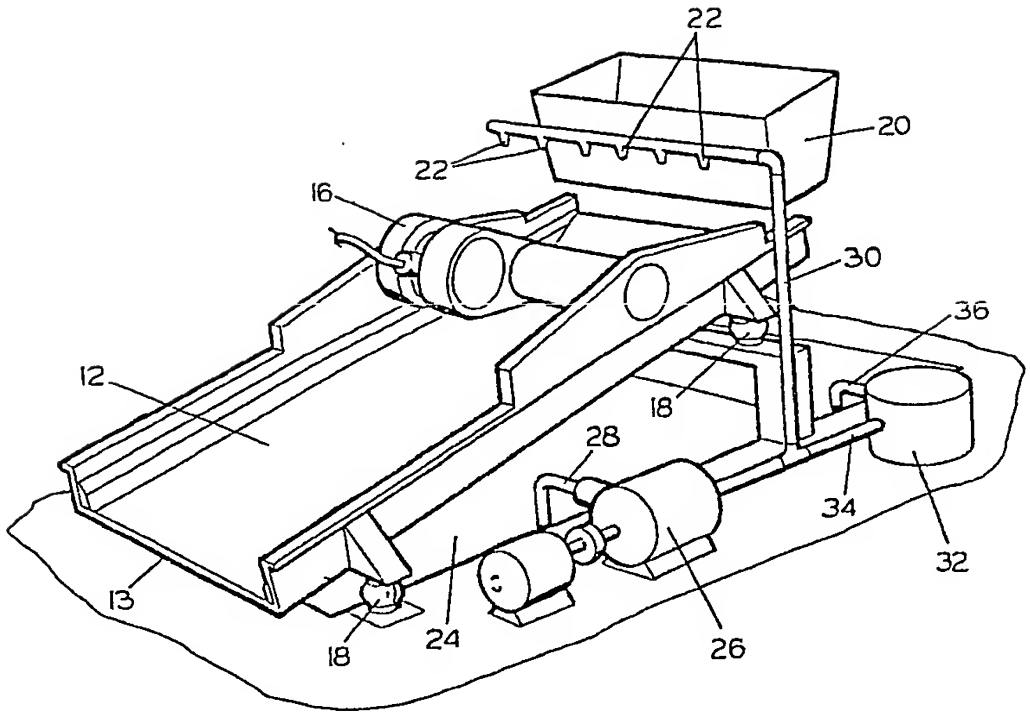

FIG. 1

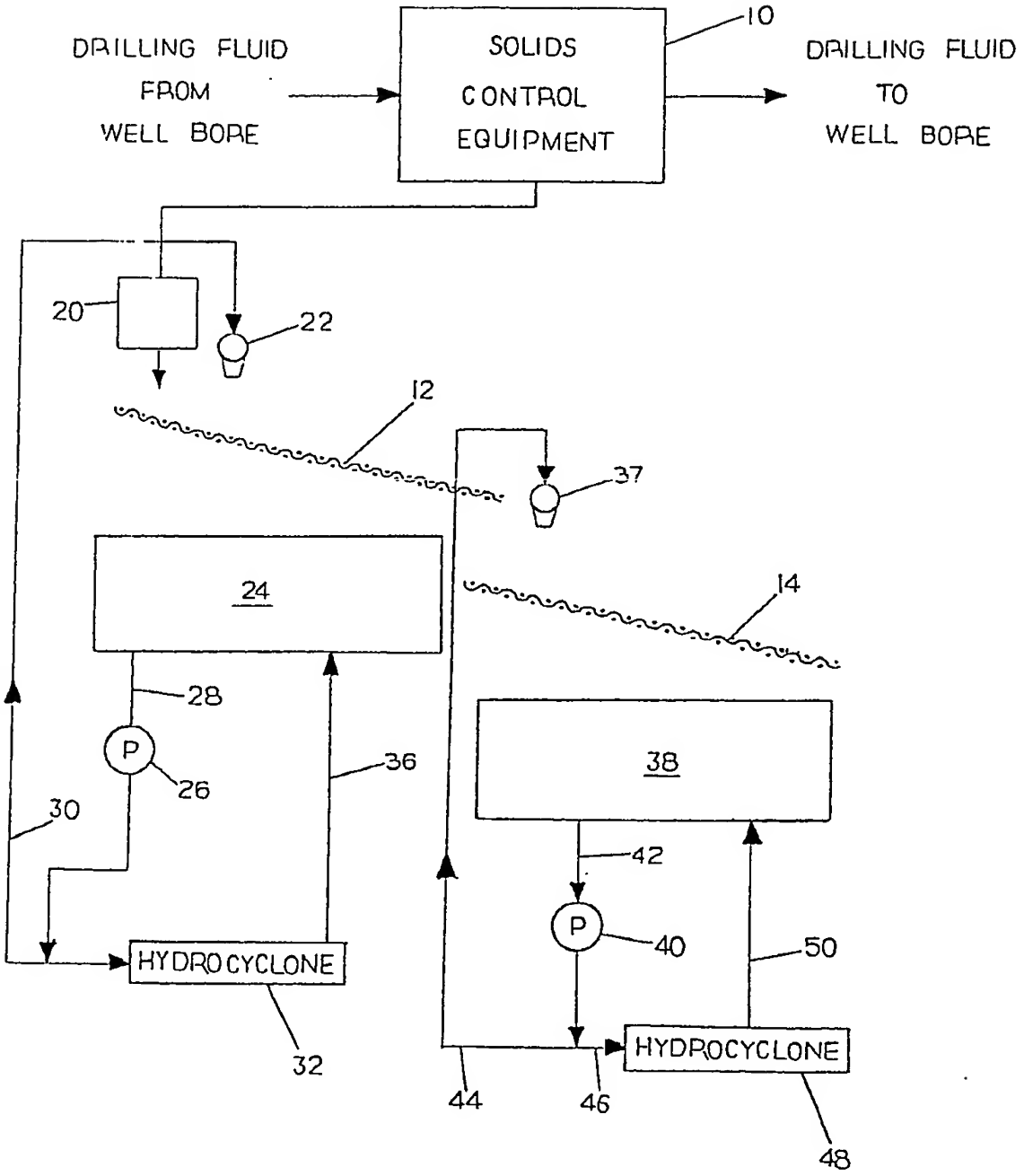

FIG. 2

SPECIFICATION

Method and apparatus for washing particulate material

This invention relates to method and apparatus for washing hydrocarbon contaminants from particulate matter contaminated with such contaminants. It is of particular value in washing hydrocarbon contaminants from cuttings separated from fluid used in the drilling, completion or work over of a subterranean well.

During the drilling of a subterranean well, a drilling fluid or mud is circulated within the well bore to cool and lubricate the drilling bit and to remove drilling cuttings from the bottom of the well. At the well head, the cuttings are removed, and the drilling fluid is recirculated. When an oil base drilling fluid is used, however, residual oil clinging to the cuttings may contaminate the environment, such as the ocean or sea. To avoid such contamination, and in some situations to comply with some government regulations, it is therefore desirable to wash such drilling cuttings before disposing of them, particularly from an offshore drilling rig.

Equipment for washing cuttings is commercially available. In known systems, cuttings are deposited in a tub containing a wash solution and are agitated therein. The cuttings are then deposited on a horizontal vibrating screen. Wash solution and oil contaminants are shaken off the cuttings particles and through the screen. The vibratory motions impel the cuttings particles off the edge of the screen into the ocean or other suitable depository.

Depositing the cuttings in a washing tube, removing them after agitation, and depositing them on a shaker is relatively time consuming; hence in some drilling and related operations even two such systems operating at the same time have been unable to keep up with the drilling rate.

A method according to the invention for washing hydrocarbon contaminants from contaminated particulate material comprises depositing the particulate material on a screen, washing it on the screen by spraying in a spray contact zone with a wash solution while vibrating the screen to promote removal of wash solution and contaminant through the screen, and causing the particulate material to move on the screen away from the spray contact zone and off the screen.

Apparatus according to the invention comprises a screen, a means for depositing particulate material on the screen, sprays for pressure spraying particulate material in a spray zone on the screen, means for vibrating the screen during the spraying and means for causing the particulate material to move on the screen away from the spray zone and off the screen.

Preferably the means for depositing the particulate material on the screen includes means for initially separating the particulate material from a fluid used in the drilling, completion or work-over of a subterranean well, and the method therefore normally includes this separation step as a preliminary step.

It is necessary to spray the particles with a sufficient amount of wash solution and under sufficient force that adequate washing of substantially all the particles is achieved. In practice this generally requires formation of a coating of the washing solution on substantially all the particles. It may be achievable by a single washing stage but the method preferably includes at least two stages, so that the apparatus includes at least two spray zones spaced apart from one another such that the polymeric material is moved away from the first zone into the second zone, and is eventually discharged off the screen. These two or more spray zones may be spaced apart from one another along a single screen but preferably the apparatus includes two or more screens. Thus the apparatus may include a first screen on which the particles are washed and from which they are discharged and a second screen positioned to collect the particles that are discharged off the first, and on which the same method may be repeated.

Preferably the or each screen is a downwardly inclined screen, with the particles being fed onto the upper region of the screen and being discharged from the lower edge. Thus the first screen may be inclined downwardly from the region on which the particulate material is deposited to its lower edge and the second screen may be positioned below the lower edge of the first screen whereby particulate matter falling from the first screen is deposited on an upper portion of the second screen.

The vibration of the screen or screens results in reduction of the moisture content of the particles as a results of removal of wash solution and contaminants through the screen. Preferably the vibration and inclination of the screen is such that the particles have their moisture content reduced to less than about 10% before they are discharged off the screen.

Generally wash solution that passes through the screen is recovered and is recirculated for subsequent washing of particulate material, generally by spraying above the same screen as that from which it was collected. During recirculation a portion of particulate material in the recovered wash liquor may be separated while the liquor passes through the recirculation path, for instance the liquor may be cleaned by a centrifuge to remove any fine cuttings particles that have fallen through the screen.

Preferred apparatus according to the invention comprises a plurality of downwardly inclined screens arranged in series, each provided with means for spraying particulate material in a spray zone on the screen and means for vibrating the screen during spraying, and in this apparatus the means for depositing particulate material onto a first screen deposit the material onto the upper portion of that screen and the second and any subsequent screens are positioned to receive on their upper portion particulate material discharged

off the lower portion of a preceding screen, and the apparatus includes also means for collecting wash solution passing through the screens and for recirculating the liquid for reuse.

Thus in the invention drilling cuttings may be washed at least twice while traveling in a continuous path. Oil-contaminated cuttings may be deposited on an inclined vibrating screen. A spray of washing solution, which may include a surfactant, is directed upon such cuttings with sufficient force to effectively coat the cuttings with the solution. The vibratory motion moves the cuttings downwardly on the inclined screen and agitates the cuttings to remove the solution and oil contaminants through the screen. After traveling down the screen and being shaken to reduce the moisture content, i.e. the entire fluid content of the treated matter, to less than about ten percent, the cuttings fall off the lower edge of the screen onto another inclined vibrating screen. Again the cuttings may be sprayed and coated with a washing solution, and shaken to remove the washing solution and any remaining oil contaminants. Advantageously, the second and subsequent washing solutions may be more dilute than the first.

The washing solutions are recovered separately below each screen, and recirculated for reuse in spraying the cuttings. During recirculation, the wash solutions may be cleaned by a centrifuge, to remove any fine cuttings particles which have fallen through the screen.

The invention is illustrated by the accompanying drawings in which:

Figure 1 is a perspective view of one of two series-operated vibrating screens used in the cuttings washer assembly.

Figure 2 is schematic block diagram showing the operation of the cuttings washer assembly.

In a typical drilling operation, drilling fluid which is circulated from the hole is separated from cuttings and particles it carries before being recirculated through the well bore. Solids control equipment, generally indicated at 10, for removing particles from the drilling fluid may comprise a desilter, a centrifuge, a cuttings shaker, and a mud cleaner. Before the removed particles are discarded oil or other hydrocarbons clinging to or otherwise associated with the particles is removed by the cuttings washer assembly.

The cuttings washer assembly comprises two inclined, vibrating shaker screens 12 and 14, nozzles 22 and 37 for spraying the cuttings with a washing solution, and recirculating and cleaning means for the washing solution.

The vibrating screens 12 and 14 are of the type disclosed in United States Patent No. 3,014,587. In general, as illustrated in Figure 1, the inclined vibrating screen 12 is actuated by an unbalanced rotary motor 16 attached to the screen 12. The screen 12 may be secured to a supporting structure by means of hollow, elastomeric isolators 18. The isolators 18 may be pneumatically expanded to tune the apparatus to achieve the desired vibratory patterns. The apparatus may thus be tuned so that the vibrations toward the top of the inclined screen tend to retard the movement of particles down the incline, thus assuring adequate time for washing and screening. Alternatively, the screen 12 may be secured to the structure by means of coiled springs, solid shock absorbers, or the like. Towards the bottom of the incline the vibratory motions assist the movement of particles down the incline of the screen 12, to effectively pitch washed particles over the lower edge 13 of the screen 12.

As illustrated in schematic form in Figure 2 two such vibrating screens are aligned in series. A chute 20 is disposed above the upper screen 12 for feeding particles from the solids control equipment 10 onto the upper portion of the vibrating screen 12. The screen 12 is disposed above the screen 14 and so arranged that the particles shaken off the lower edge 13 of the screen 12 fall onto the upper portion of the inclined screen 14. In an offshore drilling rig, the screen 14 may be so arranged that washed particles pitched off the lower edge of the screen 14 fall into the ocean.

Above the upper portion of the inclined screen 12, and adjacent the chute 20, are a plurality of suitably mounted spray nozzles 22, oriented to direct a forceful spray of washing solution onto cuttings particles deposited on the screen 12. The screen mesh is of a size that the cuttings particles remain on top of the screen while the wash solution and rinsed off oil and other hydrocarbons pass freely through the screen. A tank 24 is disposed beneath the vibrating screen 12 to recover washing solution which passes through the screen 12. A pump 26 draws solution from the tank 24 through a line 28, and recirculates the washing solution through a line 30 to the spray nozzles 22. Some fine particles will inevitably pass through the screen 12 and into the wash solution in the tank 24. To avoid the necessity of frequent changing of the wash solution as it becomes contaminated with such fine drilled solids, a centrifuge or hydrocyclone 32 is provided. A portion of the output of the pump 26 is diverted through a line 34 to the hydrocyclone and/or centrifuge 32, and thence through a line 36 to the tank 24.

Similarly, a second set of nozzles 37 and a tank 38 are associated with the second inclined vibrating screen 14. A single pump could be employed to recirculate washing solution from tanks 24 and 38 through nozzles 22 and 36. However, two separate recirculation pumps may advantageously be employed, as illustrated schematically in Figure 2. A second pump 40 withdraws water through a line 42 from the tank 38, and recirculates the wash solution through a line 44 to spray nozzles 37. A portion of the output of the pump 40 associated with the screen 14 is diverted through a line 46 through the hydrodyclone centrifuge 48 and thence through a line 50 to the tank 24. Thus two different wash solutions may advantageously be used. For example, the wash solution associated with the

screen 12 may be a highly potent detergent solution, and the solution associated with the screen 14 may be a more dilute rinse solution.

To use the cuttings washer assembly, drilled cuttings particles separated from the drilling fluid by the solids control equipment 10 are deposited through the chute 20 onto the inclined vibrating screen 12, adjacent its upper edge. A high velocity spray of washing solution is directed onto the cuttings from the nozzles 22. Preferably, the nozzles 22 produce a cone shaped spray pattern which will distribute the wash solution throughout the deposited cuttings. The solution may typically comprise calcium chloride water and a surfactant, although other components and additives may be utilised. The spray must be introduced onto the cuttings with sufficient force and in sufficient amount to effectively remove hydrocarbon contaminants from the cuttings. The fluid pressure, flow rate, and nozzle configuration may be varied to achieve this result, in known ways.

The vibratory motion of the screen 12 propels the cuttings particles down the incline, and agitates the particles to remove oil and other hydrocarbons and wash solution from the particles. Satisfactory results are achieved when the particles are retained on the vibrating screen 12 until their moisture content is less than about ten percent, by weight. As the particles are exposed to the wash solution, a low moisture content indicates that hydrocarbon contaminants have also been substantially removed from the particles.

As the particles approach the lower edge 13 of the screen 12, the vibratory motion of the screen 12 pitches the particles onto the screen 14, adjacent the upper edge of the screen 14. Here the process of washing the particles with a spray of washing solution and agitating the particles to remove wash solution and hydrocarbons is repeated. Washed cuttings particles are propelled off of the lower edge of the screen 14 into the ocean, or may otherwise be disposed.

It should be noted that a single shaker with one longer, vibrating screen could be employed, while still using two sets of nozzles, and two separate wash solutions. With such an apparatus, it would merely be necessary to divide the screen into two separate treatment zones by placement of the two sets of nozzles and tanks. Again, the screen would have to be long enough to permit sufficient agitation under the spray to substantially coat all particles with wash solution and sufficient agitation beyond the spray to substantially reduce the moisture content. A screen length of about 12 feet would be appropriate in a single screen apparatus. Moreover, the screen assembly 12 itself may be subdivided into two or more screening units, in series.

The vibrating pattern of any particular area of the screen depends upon the distance of that area from the motor, the weight distribution of the screen assembly, the speed of the motor, and tuning of the screen isolators. As disclosed by the aforementioned Philipoovic patent, the screen may be tuned to retard the downward motion of particles on the screen in some areas and to assist the flow of materials down the incline in other areas. However, as larger screens are employed, it becomes increasingly difficult to tune the system. To avoid unwanted vibrations that could impede the flow at the lower edge of a screen, it has been found preferable to use three or more shorter screens, in series, as described above.

CLAIMS

1. A method for washing hydrocarbon contaminants from contaminated particulate matter comprising depositing the particles on a screen, washing the particles on the screen by spraying in a spray contact zone with a wash solution while vibrating the screen to promote removal of wash solution and contaminants through the screen, and causing the particulate material to move on the screen away from the spray contact zone and off the screen.

2. A method according to claim 1 in which the particulate material is discharged off the screen after its moisture content has fallen below ten percent.

3. A method according to any preceding claim in which the wash solution passing through the screen is recovered and recirculated for washing particulate material.

4. A method according to claim 3 in which the recovered wash liquor includes some particulate material and a portion of this material is separated from the recovered wash solution during recirculation.

5. A method according to any preceding claim in which the screen is a downwardly inclined screen.

6. A method according to any preceding claim in which there are at least two spray zones spaced apart from one another such that the particulate material is moved away from the first zone and into the second zone and is then moved away from the second zone.

7. A method according to claim 6 carried out using at least two screens and in which particulate matter is washed in a spray zone on a first screen while vibrating the screen, is caused to move away from the spray zone and off the first screen onto a second screen and is washed on the second screen by spraying in a spray contact zone with a wash solution while vibrating the second screen to promote removal of wash solution and contaminants through the screen, and causing the particulate matter to move on the screen away from the spray zone and off the second screen.

8. A method according to claim 7 in which each screen is downwardly inclined, the first screen being downwardly inclined from the region on which the particulate matter is deposited to its lower edge and the second screen being positioned below the lower edge of the first screen whereby particulate matter falling from the first screen is depostied on an upper portion of the second screen.

9. A method according to claim 7 or claim 8 in

which at least two separate wash solutions are used in spraying particulate matter on each screen, the wash solutions respectively passing through the screens and being separately recovered and recirculated for spraying the particulate matter.

10. A method according to any preceding claim including the preliminary step of separating the contaminated particulate matter from a fluid used in the drilling, completion or work-over of a subterranean well.

11. Apparatus suitable for use in a method according to claim 1 comprising a screen, means for depositing particulate matter on the screen, spray means for spraying particulate matter in a spray zone on the screen, means for vibrating the screen during the spraying and means for causing the particulate matter to move on the screen away from the spray zone and off the screen.

12. Apparatus according to claim 11 in which the means for depositing particulate matter on the screen include means for initially separating the particulate matter from a fluid used in the drilling, completion or work-over of a subterranean well.

13. Apparatus according to claim 11 or claim 12 including means for recovering wash solution passing through the screen and for recirculating the recovered wash solution for washing the particulate matter.

14. Apparatus according to claim 13 including means for separating particulate matter from the recovered wash solution during recirculation of it.

15. Apparatus according to any of claims 11 to 14 including at least two spray zones spaced apart from one another such that the particulate matter is moved away from the first zone into the second zone.

16. Apparatus according to claim 11 or claim 12 comprising a plurality of downwardly inclined screens arranged in series, each provided with means for spraying particulate material in a spray zone on the screen with a wash solution and means for vibrating the screen during spraying, and in which the means for depositing particulate matter onto the first screen deposit the particulate matter onto the upper portion of that screen and the second and any subsequent screens are positioned to receive on their upper portion particulate matter discharged off the lower portion of a preceding screen, and in which the apparatus also includes means for collecting wash solution passing through the screens and for recirculating collected wash solution for reuse.

17. Apparatus according to claim 16 including means for separating particulate matter from the recirculating wash solution.

18. Apparatus according to claim 17 in which the means for separating the particulate matter from the recirculating wash solution comprise a centrifugal device.

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 753155	A	09-10-1933	NONE		
FR 1018282	A	05-01-1953	NONE		
US 2632366	A	24-03-1953	NONE		
US 4306974	A	22-12-1981	GB	2055597 A	11-03-1981
			GB	2055598 A ,B	11-03-1981
			US	4446022 A	01-05-1984
EP 0710509	A	08-05-1996	EP	0710509 A1	08-05-1996
			AU	3691895 A	02-05-1996
			CA	2201903 A1	18-04-1996
			CN	1159776 A ,B	17-09-1997
			DE	69415811 D1	18-02-1999
			DE	69415811 T2	10-06-1999
			WO	9611070 A1	18-04-1996
			US	5735409 A	07-04-1998
			ZA	9508390 A	24-04-1996
US 4809791	A	07-03-1989	NONE		
GB 2089403	A	23-06-1982	US	4354513 A	19-10-1982